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# Timing of fungicide protection against *Diaporthe helianthi* in sunflower

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## Abstract

*Results of protection against* Diaporthe/Phomopsis helianthi *sunflower pathogen are not always acceptable. Effectiveness of fungicide spraying is suitable when timing of spraying coincides with spreading of ascospores. Observations of infection dynamism were made with infested stem debris had been collected in Trans-Tisza region (Eastern Hungary) in 1998-2000 years. The large-scale ripening and spreading of matured ascospores start late April to early May, and the seriousness of infection determined by ecological conditions, mainly temperature and rainfall. Heavy infection developed in 1998 because of favourable temperature and rain for the pathogen. In 1999, according to the rainfall in June, infective period started a little more lately, so losses were less than in previous year. In 2000 degree of infection hardly reached the level of observation, measurable damage was not recorded. If Infection index achieves the level of 3.0 in July, losses may be considerable causing by* Diaporthe helianthi. *Application of fungicide sprayings should not timing to phenology of plant developing but spreading of ascospores, and should made signalization locally.*

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## Introduction

After its first occurrence in 1981 *Diaporthe helianthi* (anamorph: *Phomopsis helianthi*) became one of the most destructive sunflower pathogen in Hungary. Because of brown leaf spot and stem blight the assimilative area of leaves decrease, vascular and supporting tissues damage, stems break down and yield become unharvestable. Its dangerous character is even more expressed because effectiveness of chemical protection is not always acceptable. The biological features of pathogen are not known satisfactory which strongly moderate opportunities of disease forecasting. The efficacy of fungicide application is suitable only in that case when its timing coincides with spreading of primary inocula (ascospores) or happens a little bit earlier. Identification of exact time for spraying we could block breaking out epidemic.

The first occurrence of disease was observed in Yugoslavia (MIHALJČEVIĆ et al., 1980), where mycological description also happened (MUNTAŇOLA-CVETKOVIĆ et al., 1981). Since then *Diaporthe helianthi* has spread fast in all over the world. Considerable losses are caused in sunflower growing areas of middle and southern Europe. Significant damages were reported from the USA (HERR et al. 1983; YANG et al., 1984). Appearance of disease in Hungary was observed by NÉMETH et al. (1981).

α- and β-type conidia as well as ascospores can be found on the overwintered stem remains. Samples collected before winter contained asexual fruit-bodies, however by the end of winter sexual fruit-bodies were observed more frequently (MIHALJČEVIĆ et al., 1985). In Trans-Tisza region of Hungary the most of pycnidia produced β-type conidia, but α-type conidia were also observed however their rate did not exceed 20 percent.

After incubation of overwintered stem debris pycnidia developing have started in 10 days (ZSOMBIK – KÖVICS, 1999).

The pathogen survives winter in plant debris which lie on the soil surface. In depth of 5 cm the fungus destroys completely during winter. The optimum temperature for growing on Potato-dextrose-agar (PDA) is 27 °C, below 9 °C and above 30 °C growing fungus should not be observed (VÖRÖS et al., 1983). According to the observations made in Romania for mycelium growing of *Diaporthe helianthi* the minimum temperature was 14 °C, sporulation started above 18 °C, reached its maximum at 26 °C, and above 32 °C stops totally (JINGA et al., 1987). The effective sum of temperature (EST, sum of daily average temperatures above 14 °C) for developing ascospores was 252 °C. Laboratory trials made in Hungary (KÖVICS - ZSOMBIK, 2001) showed that 12 °C optimum temperature agreed with results of JINGA et al. (1987) measured in Romania, however minimum and maximum values a little bit differed. The minimum was lower (12 °C) and the maximum higher (33 °C) contrast with 13 °C minimum and 32 °C maximum published by JINGA et al. (1987). These differences should relate to the ecological plasticity of pathogen.

Beside of suitable temperature (5 to 7 days) is essential the high (above 90 %) relative humidity (RH) for spreading ascospores. Less than 50 % RH hinders developing of the fungus. 7 to 30 day-long incubation period start after the infection which depends on environmental factors (temperature and RH). Long of ascospore dispersion period lasts even for 1 to 1.5 months (CSÉP – ILIESCU, 1999). Besides of infested stem debris the pathogen can survives on wild *Helianthus* species, so can serve as source of primary inocula. By May or early June asci and ascospores are ready to leave perithecia. Ascospores germinate in drops of water and invade leaves. Fungus can grows through petioles into stem tissues. In an artificial inoculation trial the typical leaf symptoms developed when applied Hungarian isolates but failed when used American ones (HAJDÚ, 1986).

Heavy epidemic can develop when the weather is hot and rainy in the end of June and early July. For making suitable disease forecasting is essential to identify precisely the beginning of ascospores dispersion (BÉKÉSI, 1999; ZSOMBIK, 1999).

## Materials and methods

The infection dynamism of *Diaporthe helianthi* was examined in small plot trials of sunflower hybrids. Almost 50 hybrids were examined during 1998 to 2000 period yearly. Estimations were made between 20 June and 30 August. There were determined the number of infected plants and classified the observed symptoms from 0 to 10 classes on stems (ZSOMBIK, 1999). Because losses caused by breaking down stems and heads, it was advantageous to determine stem symptom categories. The Infection indices ($I_i$) were counted as follows:

$I_i = (\Sigma a_i \times i_i)/n$, where

$a_i$ = values of scale
$i_i$ = frequency of each infection scale value
n = number of total plants

Meteorological data were collected from Agrometeorological Observation Station of Debrecen University.

## Results

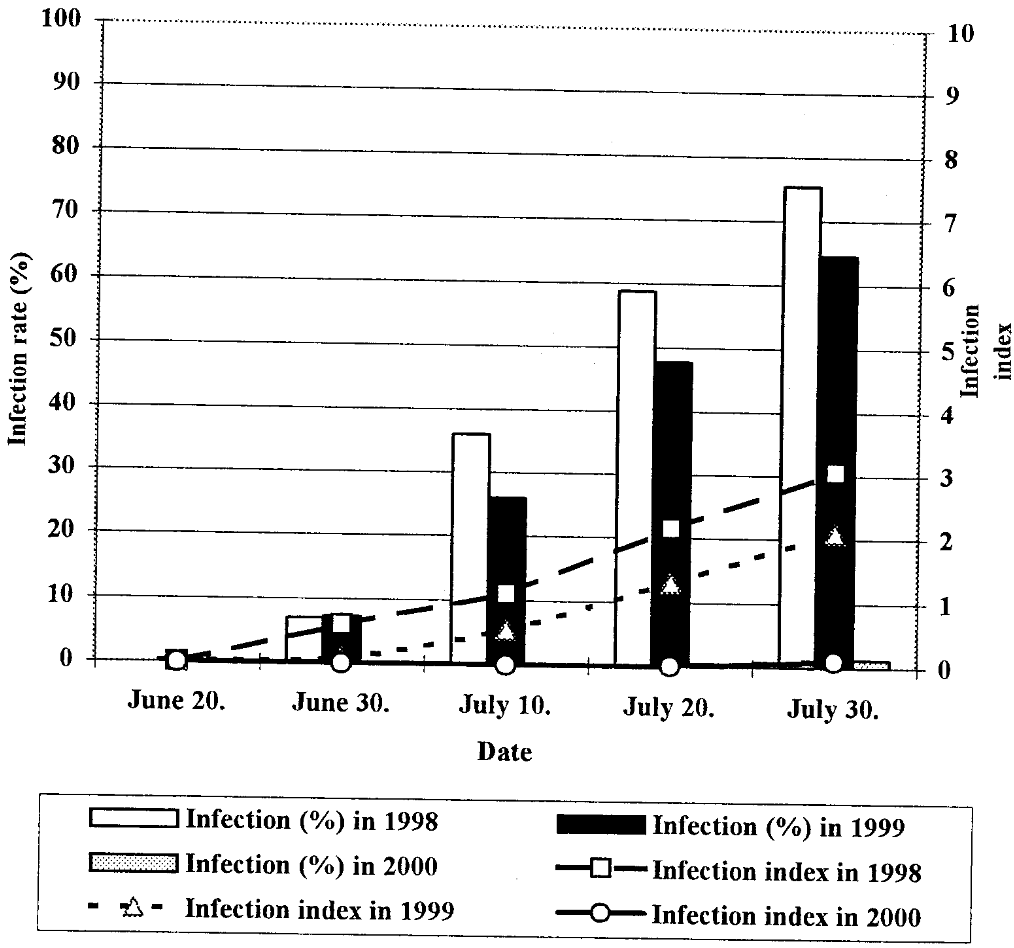
In the years of 1998 to 2000 the indices related to infection (Infection % and Infection index) are shown on the *Figure 1*. The first symptoms on the leaves were observed on 17 June 1988, and on the stems on 25 June. By the last estimation date 82,0 percent of plants were infected. The rate of infection increased the most intensively among 1 and 30 July. At the first estimation time the Infection index showed 0.6 value. The most expressive increasing (1.1 to 3.05) happened from 10 to 30 July in 1998. The final significant increase was observed in early August because of stem breaking.

In 1999 the first appeared leaf symptom occurred on 18 June. After the 10 July estimation (26 %) the infection rate increased very much, and by the 10$^{th}$ August it reached the level of 88 percent.

In comparison the year 1998 with 1999 improving infection started a week later, however there was not considerable difference in the strong of epidemic. Infection indices had increased intensively after the survey of 20 July. The average values were 1.0 less than in the previous year as far as 30 July survey, however by 10 August the values duplicated and exceeded the final value of 1988 by 0.5.

Both in 1999 and 2000 years in the August period complex infections of pathogens occurred, so evaluation of hybrids/varieties was difficult. Forced ripening of sunflower heads developed caused by mixed infection of *Diaporthe helianthi, Phoma macdonaldii, Alternaria helianthi,* and *Sclerotinia sclerotiorum.* It seems the best for estimating of probable losses to use the infection indices observed at the end of July. According to our experiences when the infection index reach or exceed 3.0 the probability of considerable losses are predictable.

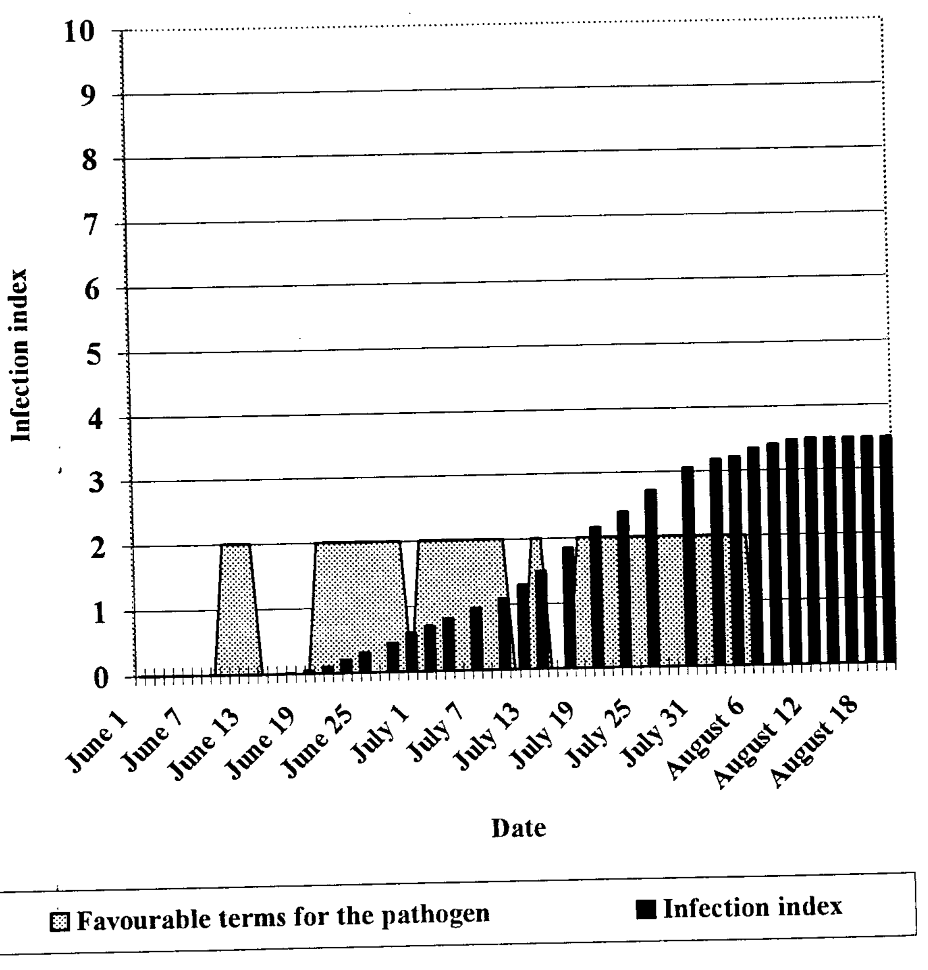
*Figure 1.* Changes of Infection rates (%) and Infection indeces of *Diaporthe helianthi* in 1998-2000 years at examined hybrides




In the 2000 year the weather with poor rainfall in the vegetation period suppressed the *Diaporthe helianthi* epidemic. The rate of infected plants hardly exceeded the level of observation, the values of Infection indices were less than 20 percent of previous years (1998 and 1999).

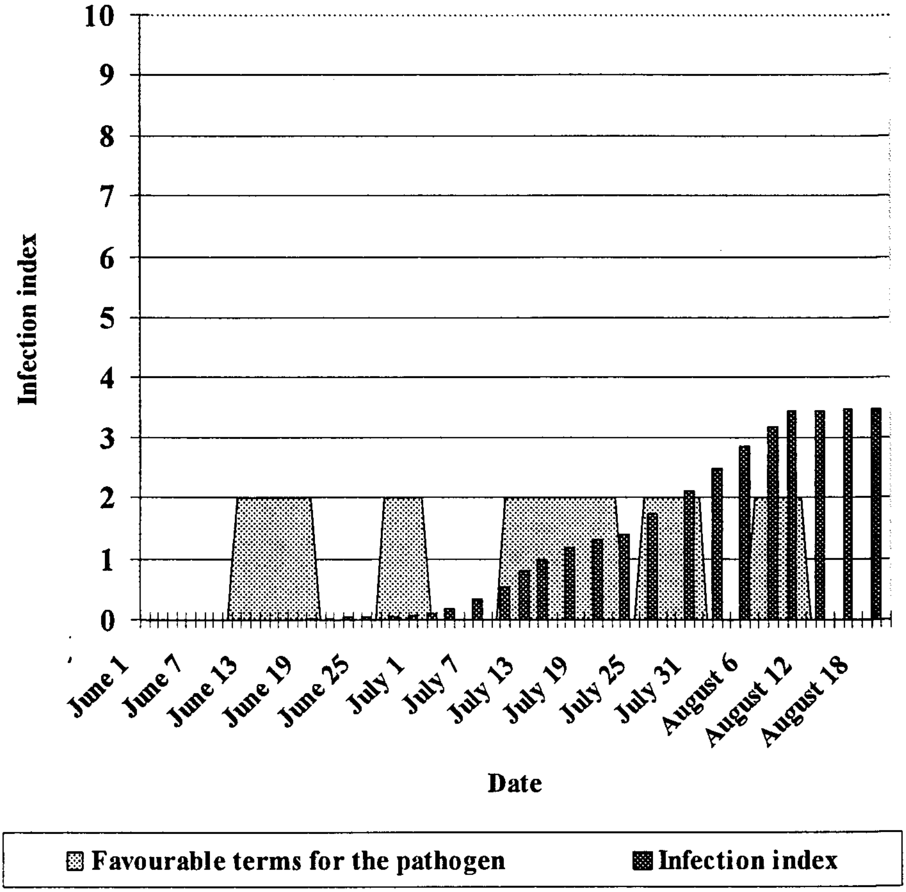
The first occurrence of perithecia could prognose by middle or end of April, which actually happened at end of April to early May in 1988. If we consider the favourable ecological periods for developing of fungus and spreading ascospores (*Figure 2*), there were longer terms in 1998 (10-12 June, 20-28 June, 1-10 July, and 13-25 July).

*Figure 2.* Relations between environmental conditions and infection in 1998



In 1999 the appearance of first symptoms almost exactly agreed that of previous year, however the perfection of epidemic showed 1 to 1.5 week delay (*Figure 3*).

*Figure 3.* Relations between environmental conditions and infection in 1999




According to our prognosis method (counting with 12 °C minimum and ca. 260 °C effective temperature) the initial time of spreading ascospores was predicted by 11-12 June 1998 which was confirmed by the actual *in situ* observation.

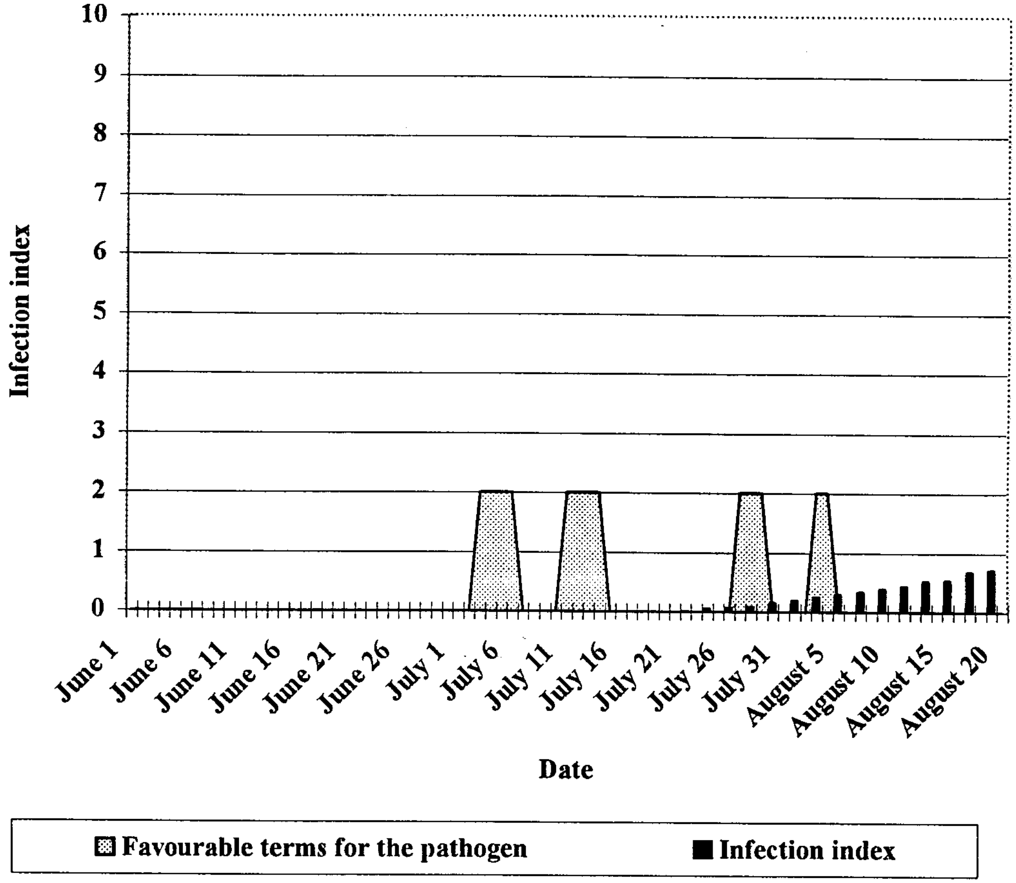
In 1999 the periods favourable for *Diaporthe helianthi* infection, determined by whether elements where shorter in June (14-19 and 28-31) with considerable interruptions. However from 10 July as long as 15 days the circumstances were optimal.

In 2000 the level of infection was low (*Figure 4*) as a result of unfavourable weather conditions. The long droughty period was interrupted only by one considerable rain in early July, however the following term was unfavourable for developing epidemic.

*Signalization and timing fungicide protection*

The presented contribution to the biological features of pathogen and epidemic features giving opportunities for suitable disease forecasting. The efficacy of fungicide application should timing to the initial spreading of ascospores instead of the often-suggested 4-6 or 6-8-leaf pairs plant phenology. By the exact timing for fungicide spraying we could block breaking out epidemic and/or moderate economic losses. These base on the locally applied prognosis methods (counting with 12 °C minimum and approx. 260 °C effective temperature) and/or the direct microscopic observations for identifying initial time of spreading ascospores. Because later on developing of disease depends mainly on the unpredictable weather, it is essential to apply fungicide sprayings making choice from wide-scale of effective fungicides.

*Figure 4.* Relations between environmental conditions and infection in 2000

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